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Original Article

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Evaluation of the clinical outcomes of the teflon felt sandwich technique in the treatment of acute type A aortic dissection accompanied by severe aortic valve insufficiency; No touch to the valve

Abstract

Aim: Acute type A aortic dissection is a life-threatening clinical situation with high mortality rates. Aortic valve insufficiency frequently accompanied to this disease. Despite the developments in the medical area, surgical intervention has difficulties especially in sinus of valsalva involvement. Aim of this study is evaluating the postoperative clinical outcomes in patients with type A aortic dissection operated without valve replacement and by using Teflon felt sandwich technique.
Material and Methods: Between January 2016 and January 2021, 126 patients with acute type A aortic dissection accompanied by severe aortic valve insufficiency operated by using Teflon felt sandwich technique without aortic valve repair or replacement were included to this study. Postoperative clinical outcomes evaluated and the degree of the aortic valve insufficiency was compared before and after operation.
Results: All the patients included to the study had severe aortic insufficiency before operation and dissected segment of the patients were limited to the ascendant aorta with sinus of valsalva involvement. Postoperative mortality rate was 6.3% (n=8). According to the results of the transthoracic echocardiography findings performed postoperative second day and first month, six of the patients had asymptomatic mild aortic regurgitation while no patients had severe or moderate aortic regurgitation.
Conclusion: Acute type A aortic dissection and accompanied severe aortic valve insufficiency can be treated by using Teflon felt sandwich technique with low duration of operation and satisfactory improvement of the aortic valve functions. Cost effectiveness in the terms of not to use a valve for replacement and anticoagulant drugs after the operation are the additional advantages.

Keywords: Aortic insufficiency, acute type A aortic dissection, teflon felt sandwich technique

INTRODUCTION

Acute type A aortic dissection is a severe clinical condition with poor outcomes. The incidence of early mortality among patients undergoing to the surgery was reported 17% to 31% in the literature (1). Tear typically begins above the sinotubular junction in the ascending aorta with the dissection flap extending into the sinus segment which causes severe aortic insufficiency (2). Despite still unresolved problems related to morbidity and mortality, surgical intervention is the only recommended treatment modality in patients with acute type A aortic dissection (3). Sinus valsalva involvement is a big challenge for the surgery that may result in uncontrollable bleeding due to anastomosis suturing of the weakened and affected aortic root (4). Accompanying aortic valve insufficiency associated with the dilation of aortic annulus leads to leaflet malcoaptation is an additional problem for the

management of the surgery (5). One of the effective techniques that accomplishes these challenging problems are reinforcement the aortic walls within two separated Teflon felt stripes.

This study aimed to emphasize the clinical outcomes especially in the terms of the aortic valve functions after a surgical procedure performed by Teflon felt sandwich technique in patients with type A aortic dissection accompanied by severe aortic insufficiency.

MATERIAL AND METHODS

Between January 2016 and January 2021, 126 patients operated for acute type A aortic dissection limited to the ascendant aorta with sinus of valsalva involvement and accompanied severe aortic valve insufficiency by using teflon felt sandwich technique included to this study. Diagnose of the disease was performed via physical examination, two-dimensional echocardiography and computed tomography (CT) scan of the chest with contrast. Written informed consent was taken from all participants and this single center retrospective study was approved by the Clinical Ethics Committee of Gaziantep University (date: 29/09/2021, no:2021/307) and complies with the declaration of Helsinki.

Extention of the aortic dissection below the sinotubular junction on the CT scan was accepted as aortic root involvement. Stages of the aortic insufficiency were evaluted according to the echocardiography findings of 2020 ACC/AHA Guideline for the Management of Patients with Valvular Heart Disease and the ratio of jet diameter to left ventricular outflow tract diameter over 65%, vena contracta width greater than 0.6 cm and effective regurgitant orifice area >0.3 cm^2 were accepted as severe aortic regurgitation (6).

Data of the patients including demographic characteristics (age, gender), laboratory findings consist of complete blood count, liver and renal functions, comorbidities, electrocardiographic and echocardiographic findings, radiographic images, medication and duration of the intensive care unit and hospital were collected from hospital records. Postoperative data included drainage, need for inotrope, duration of cross-clamp and operation, renal insufficiency, neurologic complications and reoperation due to hemorrhage were also recorded.

Patients with additional valvular heart disease, coronary artery involvement required coronary artery bypass operation, aortic total or hemiarch involvement, mild or moderate aortic valve regurgitation, younger than 18 years, pregnancy, bicuspid aortic valve complex, re-do surgery and collagen disorders like Marfan and Ehler-Danlos syndromes were excluded to this study.

Death within 30 days after surgery was defined as operative mortality and trans-thoracic echocardiography was performed on postoperative second day and first month for evaluation of the aortic valve and was compared with the preoperative results.

Surgical Technique

Urgent surgery was performed as soon as the confirmation of diagnose. Patients were operated under general anesthesia via median sternotomy. Right axillary artery or femoral artery was used for arterial cannulation and right atrium was used for venous cannulation. Cross-clamp was replaced to the ascending aorta distal to the dissected part. Cold Custadiol cardioplegia was delivered through right and left coronary ostia. Dissected aorta was removed after cardiac arrest. After this procedure, two separated teflon strips were placed around the outer and inner sites of aortic layers. 3-0 polyprophylene sutures were used to fix the felts, thus aortic walls between the felts were sandwiched (Figure 1). Thereafter, proximal anastomosis by using Dacron graft was sewn to the sandwiched structure with a 3-0 prolene running suture.

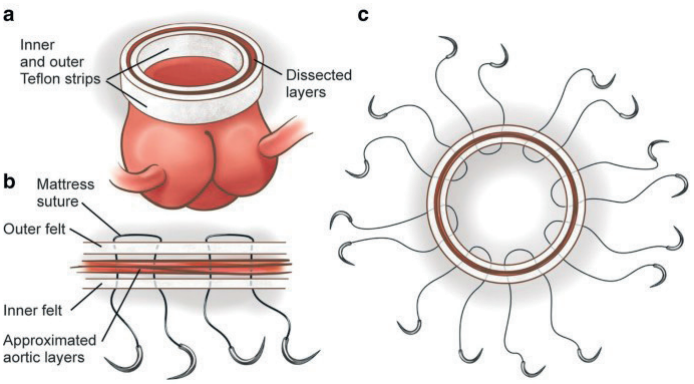

Figure 1. Teflon felt sandwich technique illustration (7)

Statistical Analyses

Data were given as mean±Standard Deviation (SD) and the number of participants and percentage. Continuous and categorical variables were given as percentages, numbers and as mean±SD, respectively. SPSS version 17.0 software (SPSS Inc, Chicago, IL) was used to calculate the statistical data.

RESULTS

One hundred twenty six patients with Stanford type A aortic dissection limited to ascendant aorta (DeBakey type II) with sinus of valsalva involvement were included to this study. Male dominancy was prevalent in the study population. There were no marked abnormalities in hemogram, renal and liver function tests of the patients. Hypertension is the most common comorbidity among the patients. Demographical and biochemical parameters of the patients were given in Table 1.

All the participants were underwent electrocardiographic (ECG) and transthoracic echocardiographic (TTE) investigation prior to the CT scan with contrast. None of the patients showed ST segment elevation according to the ECG findings. TTE revealed intimal flap limited to the ascendant aorta, valsalva of sinus involvement and severe aortic regurgitation in all the patients. Contrasted CT scan performed to confirm the diagnosis.

Intra and postoperative data such as aortic cross clamp and

cardiopulmoner bypass time, amount of drainage, requirement of inotropic medication, duration of hospital and intensive care unit (ICU) stays were summarized in Table 2.

All of the patients except of four were performed subcutaneous enoxaparin sodium six hours after operation according to the body weight with the respect of the drainage. Those of four patients re-explored because of bleeding. All patients were started acetylsalicylic acid treatment of 100 mg on postoperative first day.

Five of the patients (3.9%) had trans-ischemic attack as a neurologic complication which was improved during hospitalization. One of the patients had permanent cerebrovascular event and died soon after operation. Transitory renal insufficiency was developed in seven of the patients (5.5%) that caused pulmonary edema without respond to diuretic agents so treated with bed-sided hemodiafiltration. Four of the patients were required revision after operation due to drainage.

Patients were evaluated in terms of aortic regurgitation on postoperative second day and postoperative first month control. Results were compared with preoperative status (Table 3).

Death within 30 days after surgery was defined as operative mortality and operative mortality of the study was 6.3% (n=8). The primary reason for postoperative mortality was heart failure that developed three of the eight deaths. Two of the patients were died due to multi-organ failure and two of the patients were due to septic shock and one due to neurologic complications.

Table 1. Demographical and biochemical parameters of the patients

Parameters	Patients
Age (years)	68.32±8.2
Gender	
Male n (%)	85 (67.4)
Female n (%)	41 (32.6)
WBC (x 10^3/mm^3)	8.21±1.46
Platelet (x 10^3/mm^3)	259.36±75.78
Hgb (g/dL)	14.56±1.04
Hct	39±3
ALT (IU/L)	22.3±10.25
AST (IU/L)	23.73±9.56
BUN (mg/dL)	12.14±4.86
Creatinin (mg/dL)	0.87±0.12
HT n (%)	68 (53.9)
DM n (%)	27 (21.4)
CVD n (%)	4 (3.1)
COPD n (%)	6 (4.7)

WBC: white blood cell, Hgb: hemoglobin, Hct: hematocrit, ALT: alanine amino transferase, BUN: blood urea nitrogen, AST: aspartate amino transferase, HT: hypertension, DM: diabetes mellitus, CVD: cerebro vascular disease, COPD: chronic obstructive pulmonary disease

Table 2. Intraoperative and postoperative data

Cross clamp time (minutes)	48.35±11.38
Cardiopulmonary bypass time (minutes)	80.14±12.49
Drainage (ml)	350.12±40.24
Inotrope requirement n (%)	12 (9.5)
Stay at ICU (days)	3.21±1.14
Stay at hospital (days)	7.34±2.25

ICU: intensive care unit

Table 3. Pre and Postoperative degrees of aortic regurgitation

Aortic regurgitation (n=126)	Preoperative	Postoperative 2nd day	Postoperative 1st month	p value
Mild	None	6	6	
Moderate	None	None	None	<.001
Severe	126	None	None	

DISCUSSION

Surgical intervention is still considered as the mainstay treatment of acute type A aortic dissection although respectively higher mortality and morbidity rates because of the complexity of the surgery. Acute type A aortic dissection mortality rates if untreated, increases range between 1-2% per hour after initiation of the symptoms and in-hospital mortality rates goes up to 30% in different series (8). Involvement of the aortic root with extending flap into the sinus segment that causes aortic valve regurgitation is one of the reasons responsible from the complex surgery, mortality and morbidity (9). Replacement of the ascending aorta from coronary sinuses to the just beyond the aortic arch accepted as the mainstay approach for the acute type A aortic dissection to avoid the risk of aortic rupture or cardiac tamponade by preventing the proximal extension of the dissection (10).

Aortic root involvement can be detected in the most of the aortic dissection cases with type A which may occur due to weakened aortic wall. There may also be a connective tissue disease that may cause to same scenario in further. So, appropriate proximal aortic root procedure plays a key role (3). One of the best ways for a successful repair is reconstruction of extremely weakened dissected aortic layers both distally and proximally. This approach also helps to prevent bleeding from anastomosis that prolongs the X-clamping and cardiopulmonary bypass time leads to additional plasma and blood transfusions and increased mortality (11). Beside, successful reconstruction of the sinus of Valsalva provides the elimination of sinus dissection, prevention of aortic root bleeding and aortic regurgitation due to pseudoaneurysm or aortic root dilatation (12).

Surgical approach for acute type A aortic dissection includes excision of the dissected part of the aorta if possible, obliteration of entry into the false lumen both proximal and distal edges and interposition of synthetic graft of the ascendant aorta. Aortic valve replacement may be required depending on underlying pathology of the aortic valve and root. Coronary artery bypass graft operation is necessary in any involvement of the coronary structures (13). Several operation techniques were described in the literature for the treatment of type A acute aortic dissection. Interventional techniques include transcatheter fenestration and thoracic endovascular aortic repair. Surgical techniques were introduced as unique ascending aortic replacement, ascending aortic replacement with aortic valve replacement separately, ascending aortic replacement with aortic valve replacement together by using composite aortic valve graft (Bentall procedure), ascending aortic replacement with valve sparing procedures like David or Yacoub technique. Additionally if the dissection radiates to the inner curvature of aortic arch, hemiarch replacement and if extends to the whole arch, total arch replacement with the reimplementation of supraaortic vessels separately or by using island technique can be performed as well as Elephant trunk technique (14).

Leaflet malcoaptation due to enlargement of the functional aortic annulus, cusp prolaps caused by commissural disruption and leaflet impingementation by the dissection flap are the major reasons of aortic insufficiency associated with aortic dissection. However, tissue is the cusp is normal and associated cusp pathology is observed occasionally in the majority of the cases that offers opportunity to perform aortic valve preservation, aortic valve reconstruction or valve sparing surgeries instead of aortic valve replacement (5).

Teflon felt sandwich technique is a novel procedure used in acute type A aortic dissection with aortic insufficiency to ensure valve spare and sinus of Valsalva repair. Placement of the Teflon felt stripes around the internal and external sides of the whole non-coronary sinus of Valsalva wall covers the dissection of the sinus of Valsalva and reinforces the entire non-coronary sinus and the sinotubular junction of the left and the right sinuses. Thus, aortic valve preservation can be achieved without any intervention. Nevertheless this method is not recommended in the presence of connective tissue disorders like Marfan syndrome, aortic valve disease, intimal tear of the sinus cavity and root aneurysm wider than 4.5 cm (2). In our study all participants with acute type A aortic dissection have severe aortic insufficiency as patients with mild and/or moderate insufficiency excluded from study.

Several advantages can be mentioned about Teflon felt sandwich technique in the treatment of acute type A aortic dissection accompany severe aortic valve insufficiency such as shortening of the cross clamp and cardiopulmonary pump time, decreased requirement of blood or/and blood products and inotropic support, shortening of the duration of hospital and intensive care stay and no need to use lifelong anticoagulant therapy due to prosthetic valve (9).

All kinds of prosthetic valves, either mechanical or bioprosthetic, used in aortic valve replacement procedure may represent serious clinical problems such as thrombosis, tissue overgrowth, infection, mechanical or structural failure and tissue deterioration. In addition subjects who have mechanical valve(s) are required to use lifelong anticoagulation therapy in order not to develop

thrombosis that leads to functional stenosis or regurgitation of the valve due to interference of the movable parts by thrombus (15). If aortic valve is functioned but leaflets are malcoaptated that results insufficiency and diameter of the sinus of Valsalva <4.5 cm, Teflon felt sandwich technique improves the regurgitation by compacting the annulus without aortic valve replacement. Therefore it allows avoiding from undesirable clinical situations mentioned above. In addition no need of lifelong anticoagulant therapy relieves patients of routine INR controls. In coherence with the study performed by Tang et al (2), our study relieved satisfactory outcomes in terms of regression of the preoperative aortic regurgitation to normal limits except six of the patients with asymptomatic mild aortic insufficiency in postoperative period. Postoperative mortality was declared 6.6% in the same study which is parallel to our results.

Excessive bleeding is accepted as a challenging problem in surgery for acute type A aortic dissection. Various risk factors were recognized related to bleeding. First of all, aortic dissection itself causes dysregulation of the coagulation cascade that tends to massive bleeding (16). Preoperative dual antiplatelet therapy was found to be associated with both postoperative bleeding and increased mortality (17). Beside these, age, hypertension, coronary artery disease, duration of aortic cross clamp and cardiopulmonary bypass were identified as another risk factors for massive bleeding in the surgery of type A aortic dissection (16). As the Teflon felt sandwich technique don't include further procedure like aortic valve replacement in suitable cases, duration of aortic cross clamp and cardiopulmonary bypass shorter than the procedures that include aortic valve intervention. Thus, major bleeding conditions are thought to be much lesser due to shortened duration of side clamp and pump which has undesirable effects on coagulation system.

Besides bleeding problems, postoperative thrombosis of false lumen was also found significantly lower in patients operated by using Teflon felt sandwich technique (18).

Bleeding from anastomotic suture lines is another problem related to bleeding. Teflon felt sandwich technique provides sufficient reinforcement to dissected tissue and prevent tears and bleeding from the needle holes. While the stabilization of the aortic root achieved, it also prevents aortic root aneurysm (9). White et al (19) reported that reduced suture line bleeding and requirement of postoperative blood products can be achieved by Teflon felt sandwich technique. In our series among 126 patients only four of the patients underwent revision operation due to major drainage.

Biologic glue is one of the tools that is used in repair of the proximal aortic dissection. Because of several complications caused by the use of glue were defined in the literature such as systemic embolism, postoperative heart blocks, redissection or false aneurysm and difficulty in achieving hemostasis it was not preferred in our study population (20).

In a study designed by Leontyev et al (21), high dose inotropic support was supposed to be risk factor in-hospital deaths in patients undergoing surgical intervention for acute type A aortic dissection. Similarly, a study performed by Girdauskas et al (22), five of the six patients were died to whom were administered high dose inotropic medication after the operation for acute type A aortic dissection. High dose inotropic support is slightly associated with prolonged mechanical ventilation support which was found to be an independent factor of morbidity and mortality in patients with prolonged cardiopulmonary bypass and side clamp duration (23). In addition, long duration of cardiopulmonary bypass and side clamp were reported to be risk factors for hypoxemia which is responsible for prolonged intensive care unit stay and delayed hospital discharge (24). In Teflon felt sandwich technique in suitable patients with acute type A aortic dissection with aortic valve insufficiency, because of not to touch the aortic valve these periods are shorter than to whom had aortic valve intervention.

Besides, comorbidities have important roles on postoperative mortality. In a study designed by Demir et al (25) mortality rates of the patients operated with Teflon Felt was 28%. However the population in that study has serious and high-rated comorbiditeis such as; DM (38%), HTN (92%) and CVD (15%) which may related to high mortality rates. Contrary to this study, only 3 of 34 patients were died in another study in which the number of comorbiditeis is relatively lower than that study. Moreover, despite nearly 4 folds of CVD than our study, Strauch et al (26) reported nearly the same postoperative mortality rates in our study.

Absence of the long term follow up can be considered of limitation of this study.

CONCLUSION

In conclusion, Teflon felt sandwich technique can be an option in suitable subjects with acute type A aortic dissection. This technique enables to correct severe aortic insufficiency without touching to the valve that shortens the cardiopulmonary bypass and side clamp durations associated with adverse postoperative outcomes.

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Ethics Committee Approval: The study protocol was approved by the Clinical Ethics Committee of Gaziantep University, Türkiye (date: 29/09/2021, no: 2021/307). The study was conducted in accordance with the principles of Declaration of Helsinki.

Patient Informed Consent: A written informed consent was obtained from each patient.

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